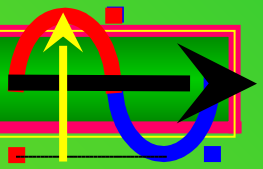
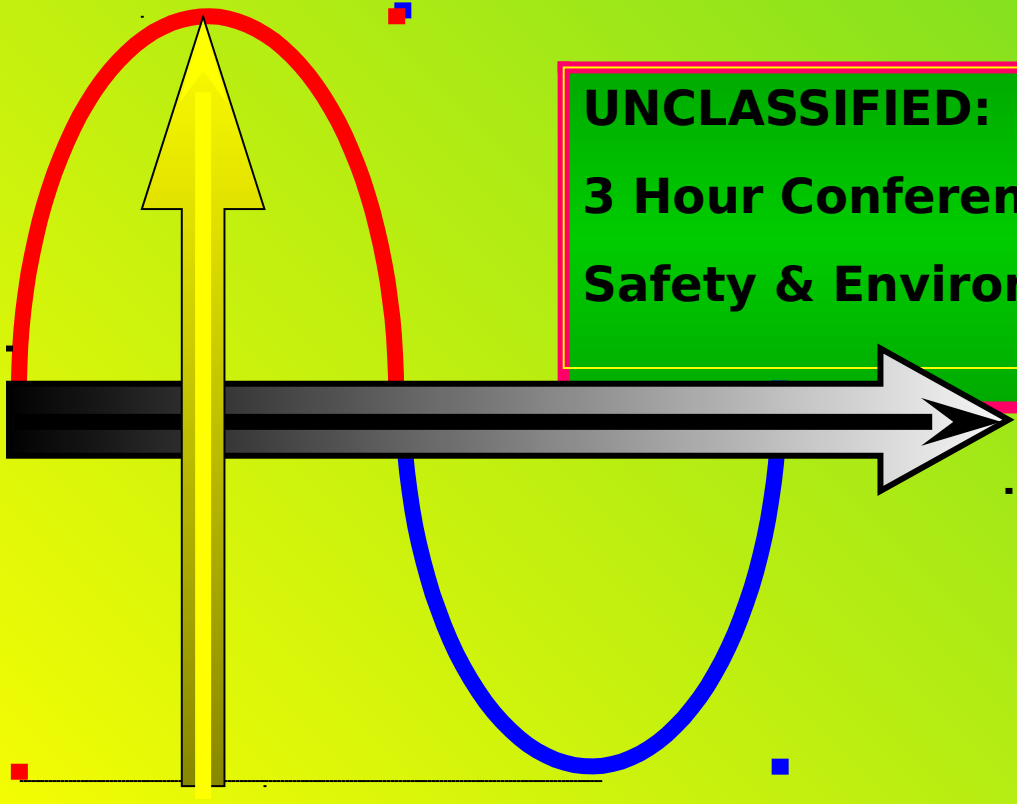
AC:



Introduction To AC

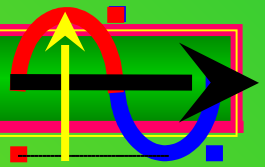


UNCLASSIFIED:

3 Hour Conference W/2 Hr PE3

Safety & Environmental Impact: “ LOW ”

AC: Introduction To AC



Terminal Learning Objective

ACTION:

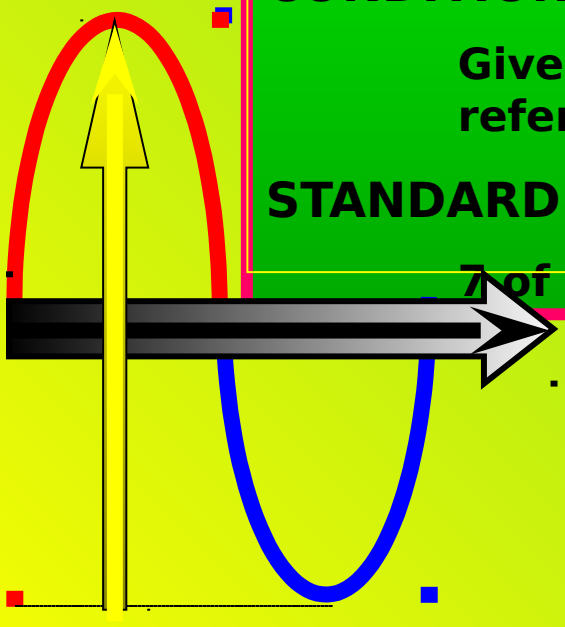
Calculate AC Voltages, Period, Pulse Width & frequency, utilizing the AC Concepts W/in this lesson.

CONDITIONS:

Given problems and Official OMEMS Training Aid reference.

STANDARD:

7 of 10 questions must be answered correctly.



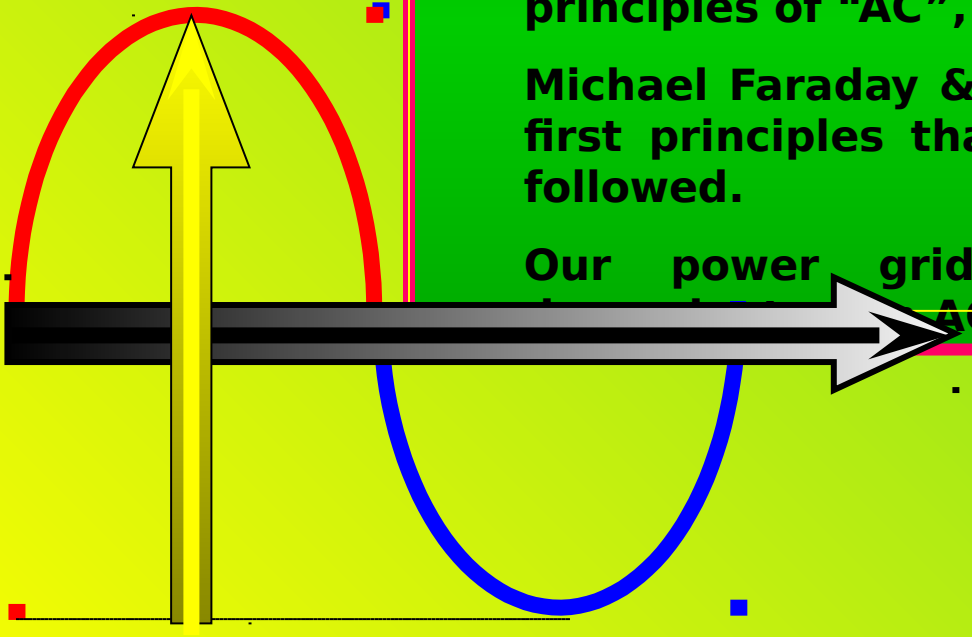
Introduction

Up to this point you have dealt with Direct Current, current that is constant in magnitude & flows in one direction.

With this conference you will be introduced to the basic concepts & terms that define principles of “AC”, Alternating Current.

Michael Faraday & Joseph Henry uncovered the first principles that defined AC for those that followed.

Our power grids & Communications are [illegible] AC.



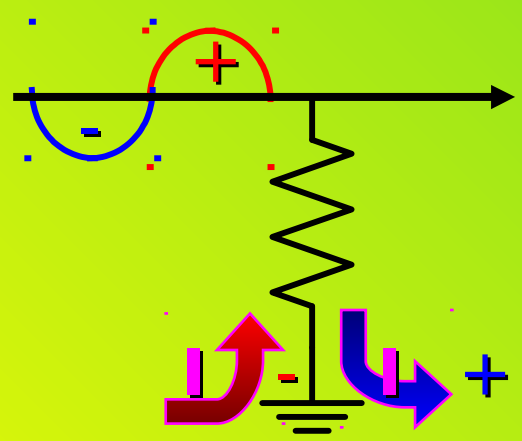
AC: Intro To AC; Concepts

AC;

<u>Alternating Current</u> is current that flows in one direction then in the other.

Or current that changes in Amplitude & Periodically reverses direction.

Current will still flow toward the most positive point in the Ckt, the difference w/AC is, the polarity will aiternateiy change.



Change in Amplitude

Current Periodically changes direction.

AC: Intro To AC; Magnetism

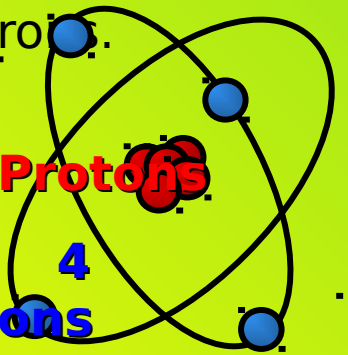
Magnetism; **Is the ability to attract Iron or Iron based Materials,** **[Ferrous Materials].**

3 Types of Magnets;

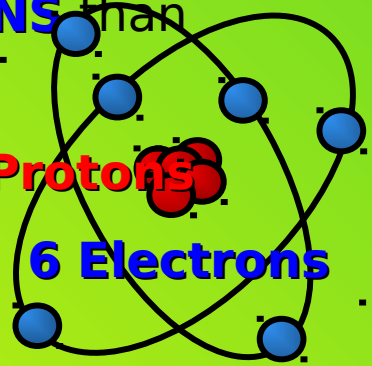
1. **Natural** [Magnetite]
2. **Permanent**
3. **Electromagnet** [Wire wrapped around an Iron core]

Atom; **The smallest electromagnetic particle.**

+ ION Atom has More **PROTONS** than electrons.

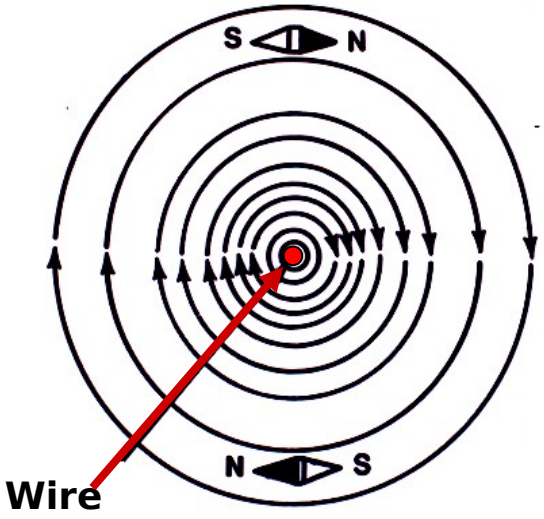


− ION Atom has More **ELECTRONS** than Protons.



AC: Intro To AC; Magnetism

As Current flows through a conductor it creates a Magnetic Field or lines of Force, [Flux Lines].



Magnetic field is perpendicular to the Conductor [Wire]

Lines form closed loops
Lines do not cross

Lines become weaker as distance increases from the source.

Law of Magnetism;

<u>Opposite</u> poles or forces <u>Attract</u>.

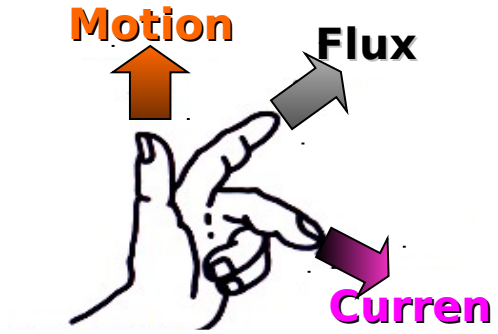
<u>Like</u> poles or forces <u>Repel</u>.

AC: Intro To AC; Generation

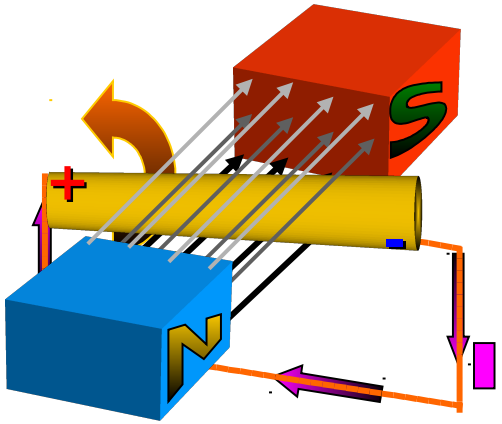
3 Requirements to Generate AC;

1. **Motion.**
2. **Magnetic Field** [or Flux Lines].
3. **Conductor** [Wire].

Generator; **<u>Converts mechanical energy to electrical energy</u>**
by **the conductor loop cutting through the Magnetic Field inducing Voltage & Current.**



Left Hand Generator Rule

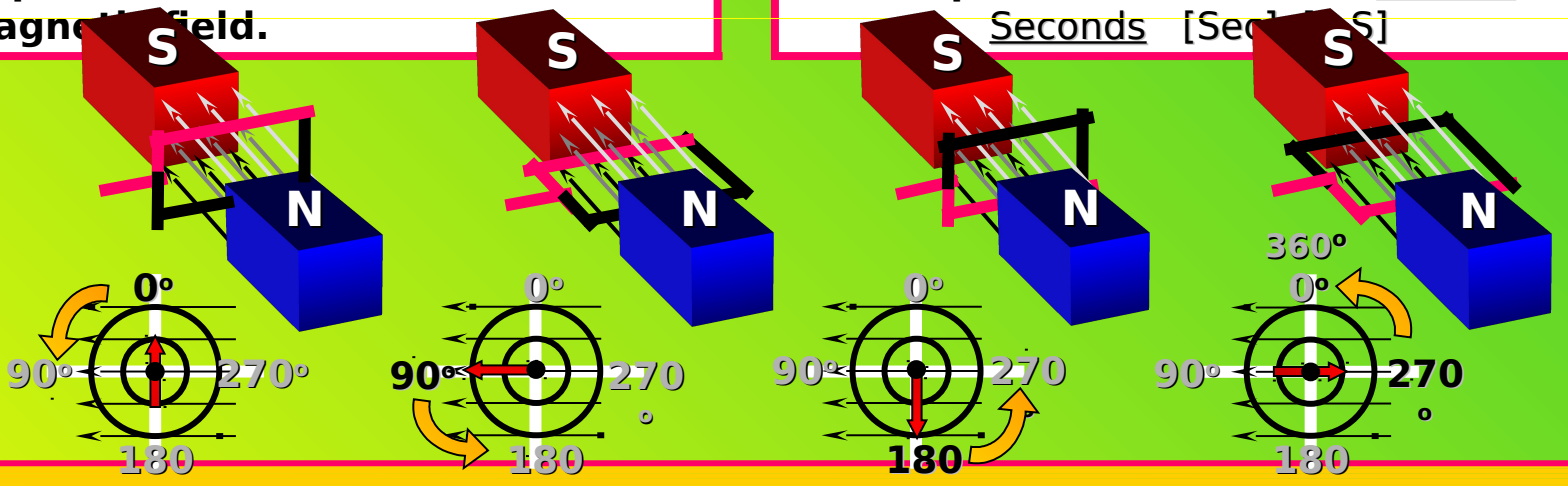


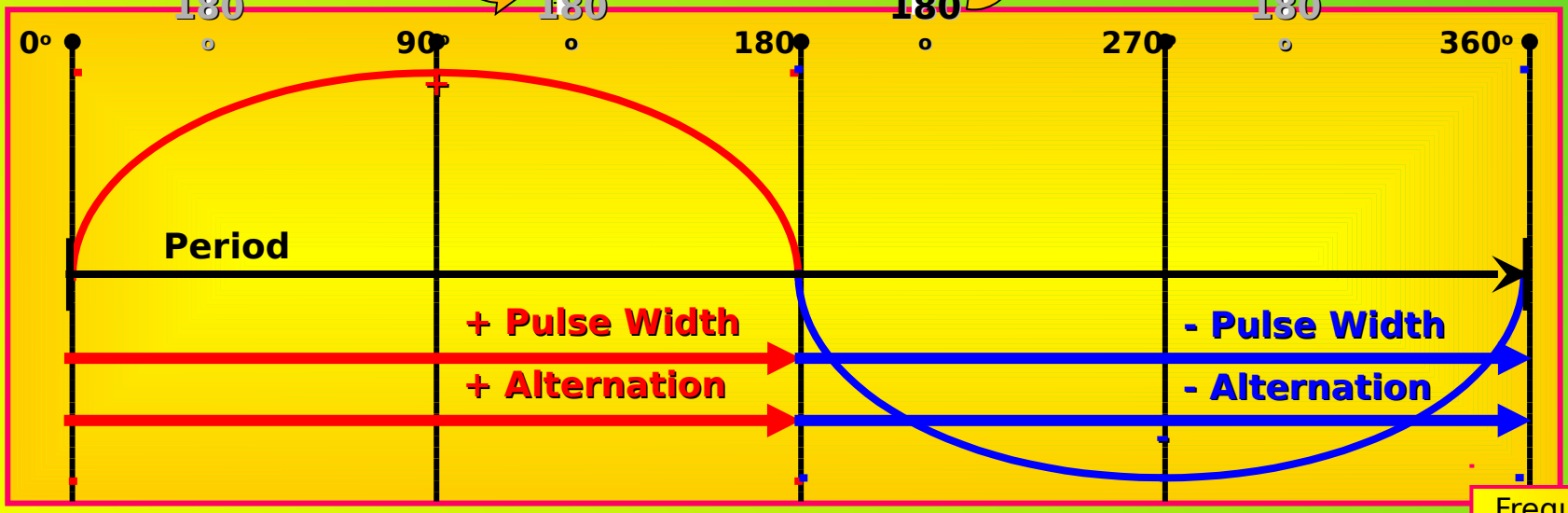
Period

AC: Intro To AC; Period

Sinewave; Is the Voltage Generated in relation to the angle or position of the rotor in the magnetic field.

Period; The amount of time required for the rotor to make 1 complete revolution. In units of Seconds [Sec]onds [S]





Frequency

AC: Intro To AC; Frequency

Frequency;

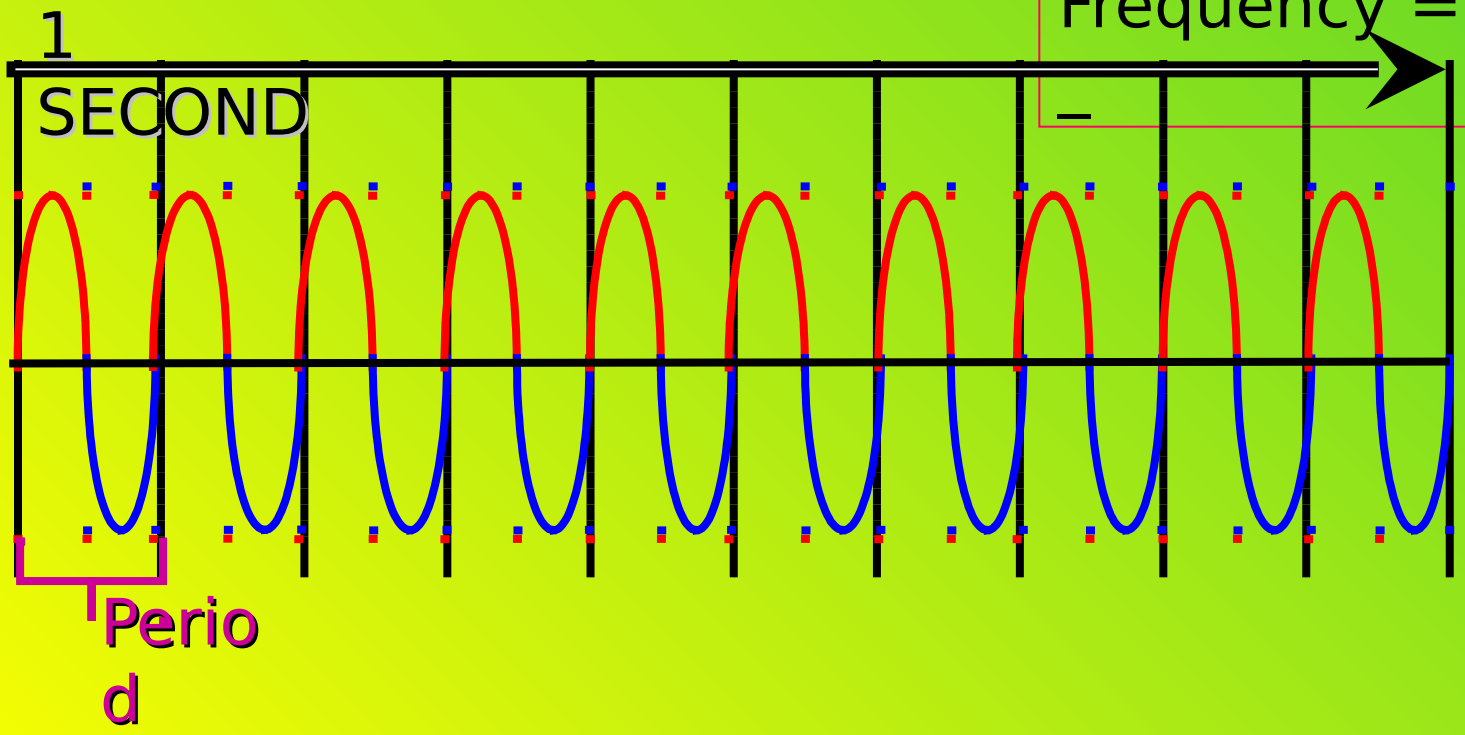
Is the <u>number of complete revolutions</u> [360°] of the Generator <u>in 1 Second</u>.

Unit of Measure;

Hertz, Hz, [KHz].

Note; Frequency cannot be measured on the O Scope.

Frequency = __?
_



conversio
ns

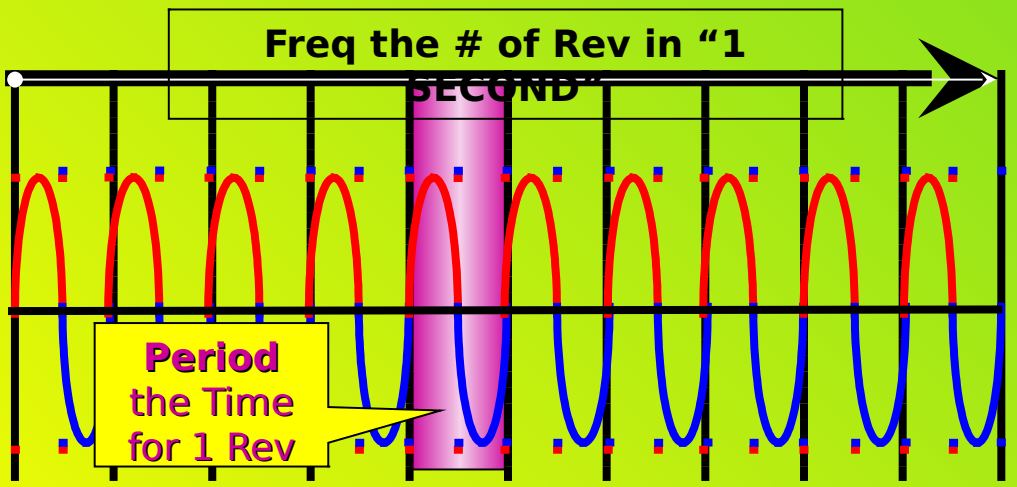
AC: Intro To AC; Frequency

Period to Frequency; If Period is known, Frequency is calculated.

1/ Period or **[Period 1/X] ⇒ Freq In [Hz]**

Frequency to Period; If Frequency is known, Period is calculated.

1/Freq or **[Freq 1/X] ⇒ Period In [SEC]**



Frequency

$$\frac{1}{\text{Period}} = \frac{1}{.1\ \text{Sec}}$$

.1 Sec 1/X ⇒ 10 Hz

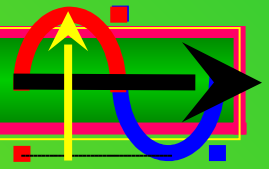
Period

$$\frac{1}{\text{Freq}} = \frac{1}{10\ \text{Hz}}$$

10 Hz 1/X ⇒ .1 Sec

Review

AC: Intro To AC; Review



AC;	**Alternating Current, Current that changes in Amplitude & Periodically reverses direction.**
3 Types of Magnets;	**1. Natural** [Magnetite] **2. Permanent 3. Electro.**
Law of Magnetism;	**Opposite's Attract, Like's Repel.**
Generator;	**Converts mechanical energy to electrical energy.**
3 Requirements to Generate AC;	**1. Motion, 2. Flux, 3. Conductor.**
Sinewave; or	**Is the Voltage Generated in relation to the angle position of the rotor in the magnetic field.**
Period;	**The amount of <u>time required</u> for the rotor to make 1 <u>complete revolution</u>. In <u>units</u> of Seconds [Sec], [μS] .**
Frequency;	**Is the <u>number of complete revolutions</u> [360°] of the Generator <u>in 1 Second</u>. In <u>Units</u> of Hertz, [Hz], [KHz].**
Period to Frequency;	**1/ Period or [Period 1/X] ⇒ Freq** In **[Hz]**
Frequency to Period;	**1/Freq or [Freq 1/X] ⇒ Period** In **[SEC]**

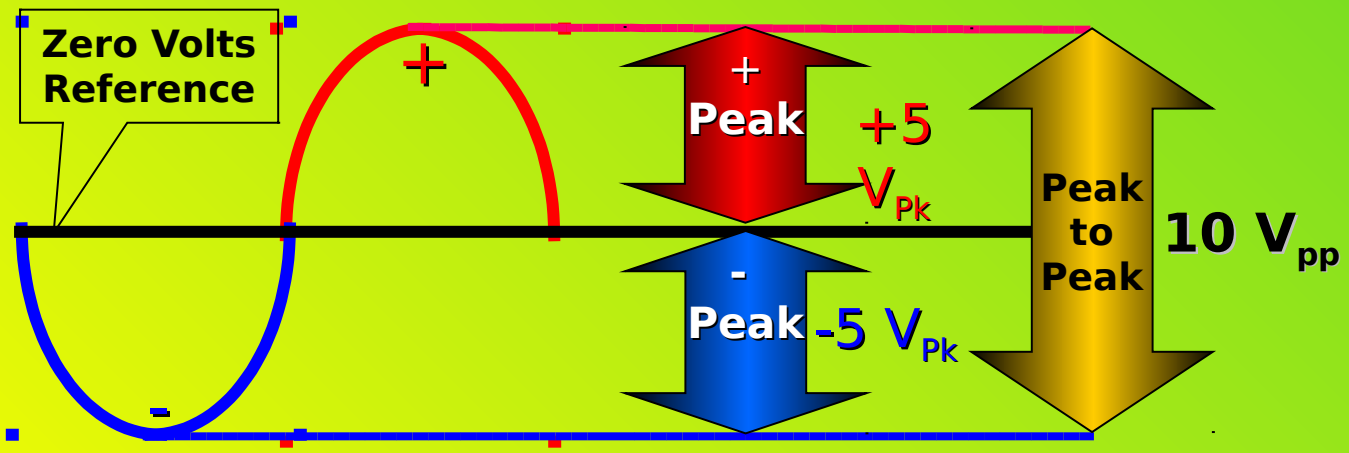
AC Voltages

AC: Intro To AC; Voltages

AC Voltages & Equivalent Values;

AC Voltage has 3 different numerical values for the same Voltage.

1. **Peak** [pk]
2. **Peak to Peak** [PP]
3. **RMS or Effective** [VAC]



Peak X 2 = Peak to Peak

PP ÷ 2 = Peak

The O-Scope is used for P & PP measurements.

RMS

AC: Intro To AC; Voltages

AC Voltages & Equivalent Values;

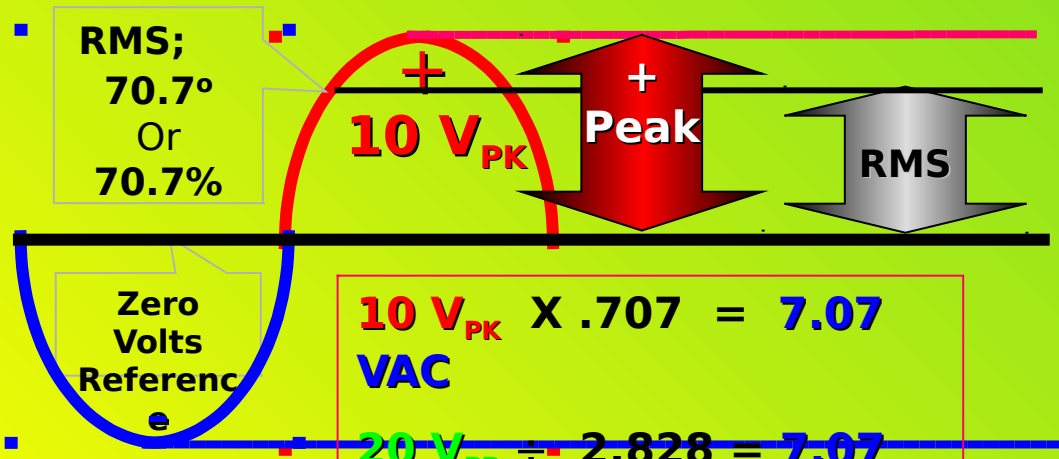
RMS {EFF} **;** **Root Mean Square** also Known as **Effective Voltage**.

.707 or 70.7% value **Is the mathematical constant that represents the of AC required, to do the same work as DC.**

RMS, **Read the Meter Student!**

VAC **Professionally understood as the RMS AC Voltage.**

Peak or **Peak to Peak; AC voltage MUST be labeled as such.**



10 V_{PK} X .707 = 7.07 VAC

20 V_{PP} ÷ 2.828 = 7.07 VAC

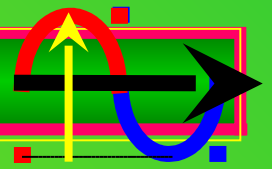
Peak X .707 = RMS or **EFF**

Pp ÷ 2.828 = RMS or **EFF**

The DMM is used for RMS measurements.

Conversions

AC: Intro To AC; Voltages



AC Voltages & Equivalent Values; Conversions

PP ÷ 2 = P

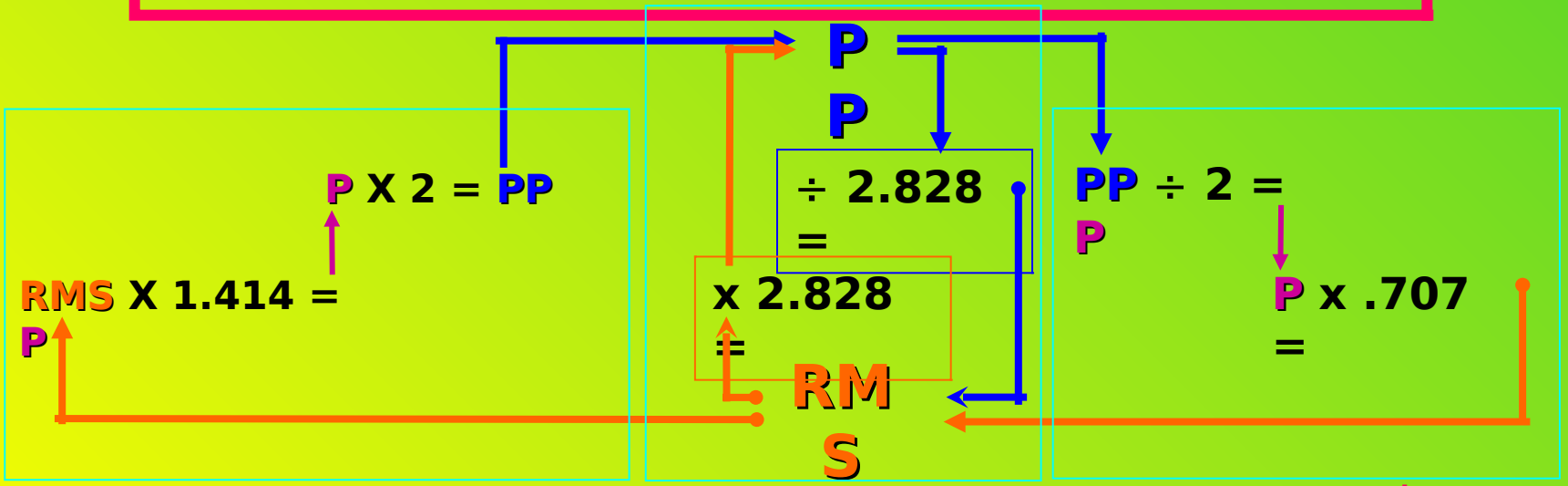
P X .707 = RMS or EFF

RMS X 1.414 = P

P X 2 = PP

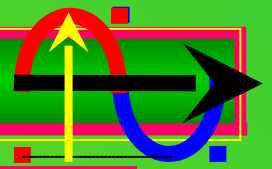
PP ÷ 2.828 = RMS

RMS x 2.828 = PP



Challenge

AC: Intro To AC; Voltages



AC Voltages & Equivalent Values; Conversions

You went to buy a new stereo system, the salesman showed you a system that puts out "200 Watts" of power, the salesman will give you the power rating that makes the most impressive sale. How much power are you really getting for your money?

Watts Peak____? **Watts RMS ____?**

Note: Ac Voltage & Power Conversions are calculated the same way.

PP ÷ 2 = P

P X .707 = RMS or EFF

PP ÷ 2.828 = RMS

RMS X 1.414 = P

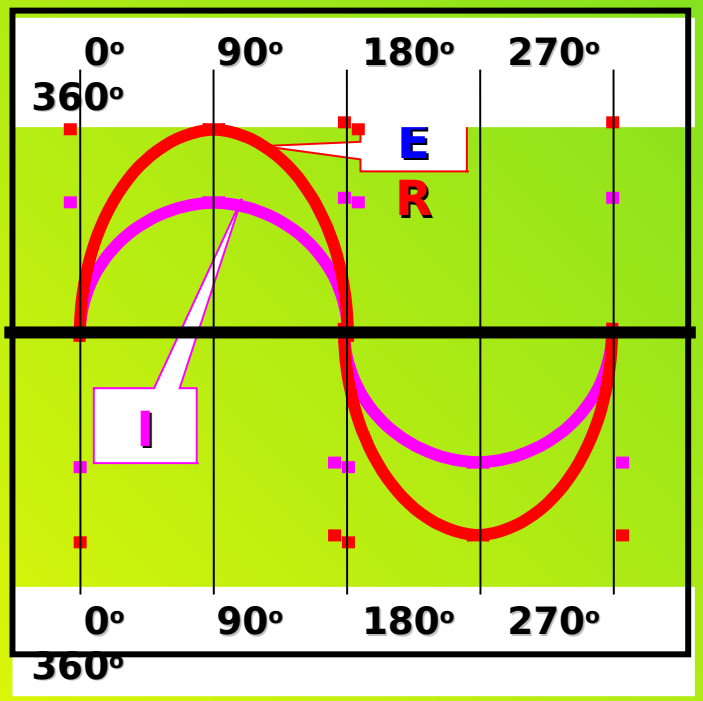
RMS X 2.828 = PP

P X 2 = PP

Phase

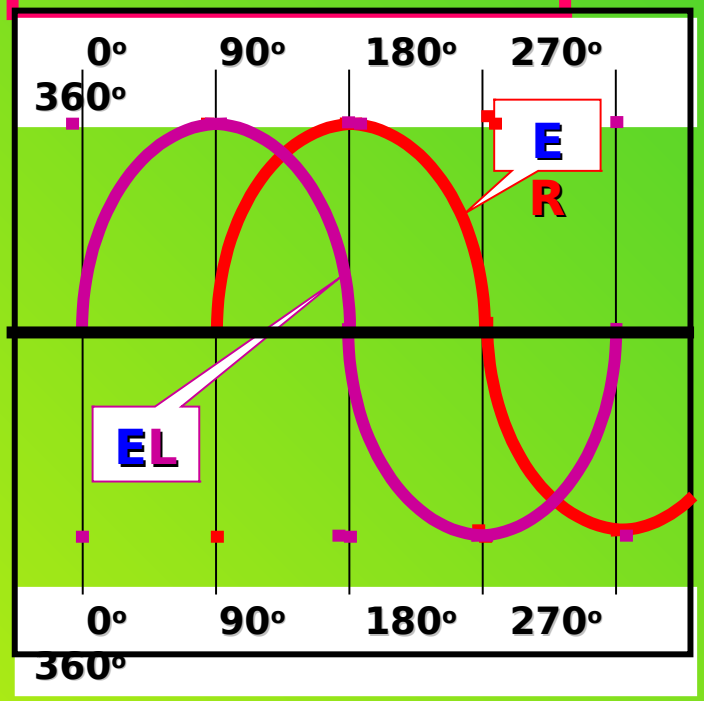
AC: Intro To AC; Phase

IN Phase; Sine



Resistor Voltage & Current are IN Phase.

OUT of Phase; Sine

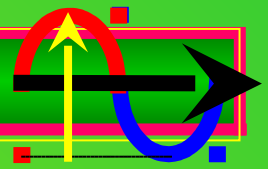


The EL is Leading the Voltage across a Resistor by 90°.

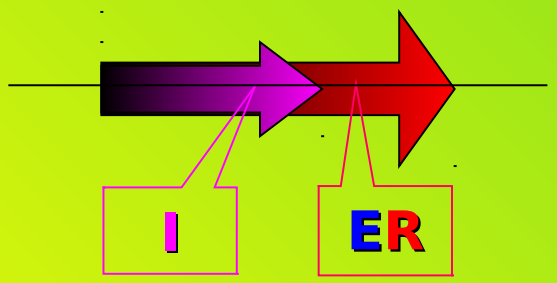
Or the ER is Lagging the EL by 90°.

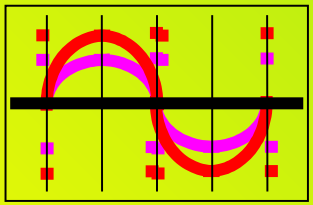
Vectors

AC: Intro To AC; Phase

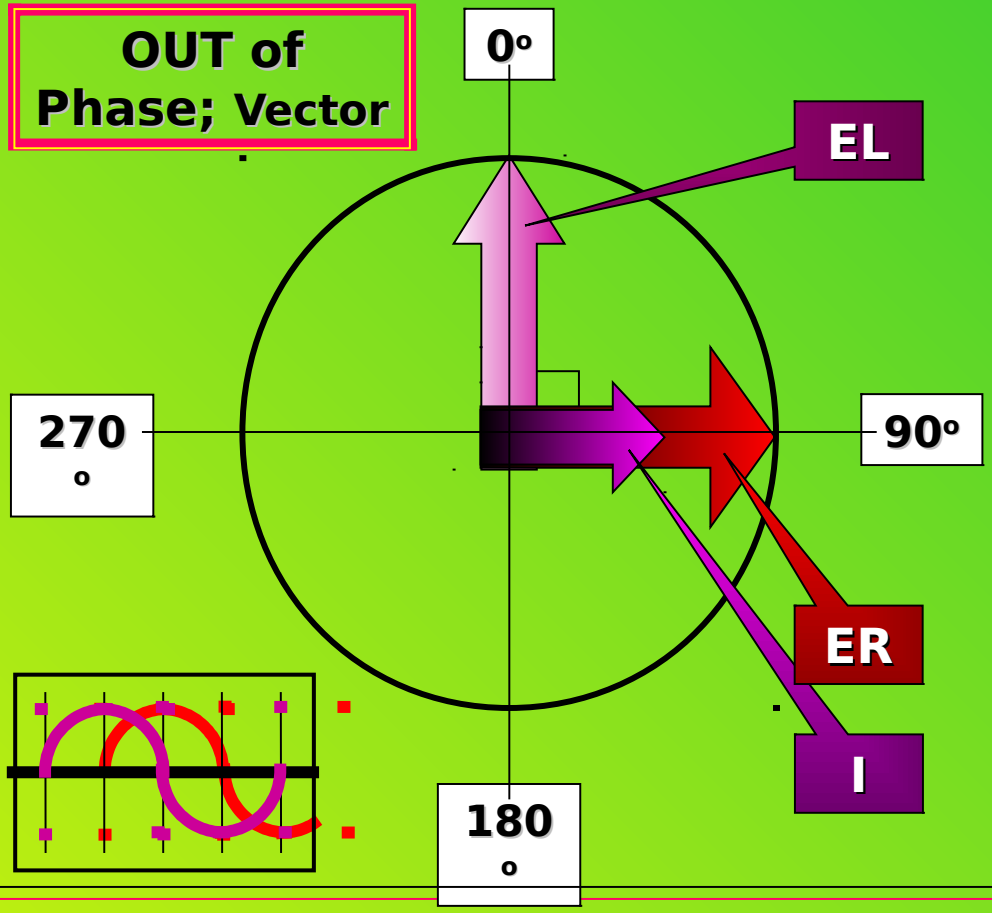


IN Phase; Vector





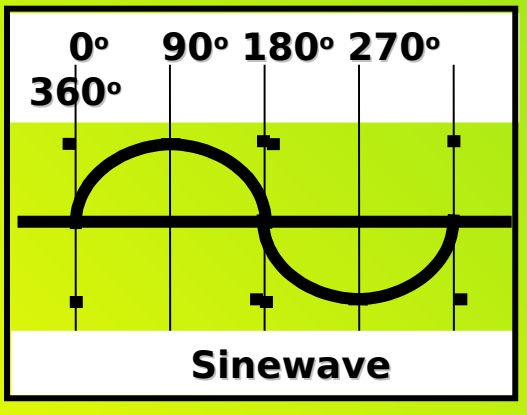
OUT of Phase; Vector

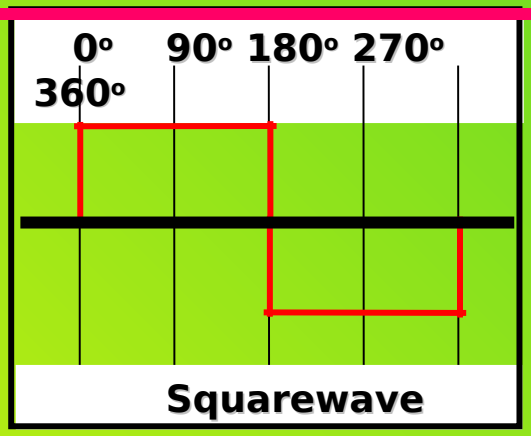


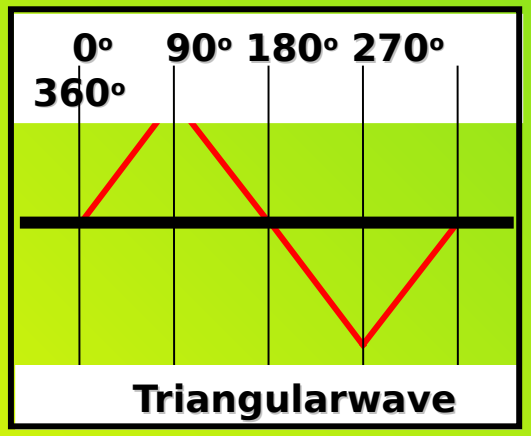
When reading a Vector, read counterclockwise; the entity that reaches the 12:00 position 1st is leading.

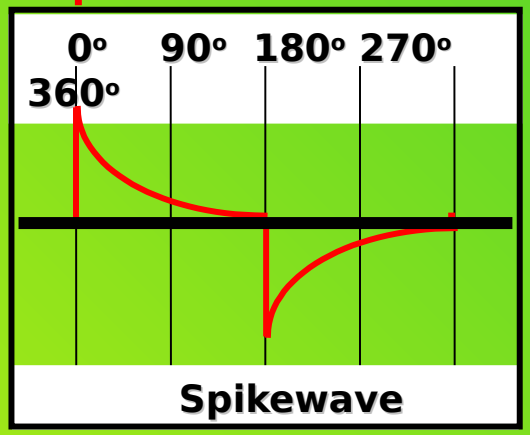
AC: Intro To AC; Wave Forms

Waveforms; 3 Frequency same. Outside of the Sinewave, waveforms fall into basic types. All calculations, Period & and Voltages are calculated the





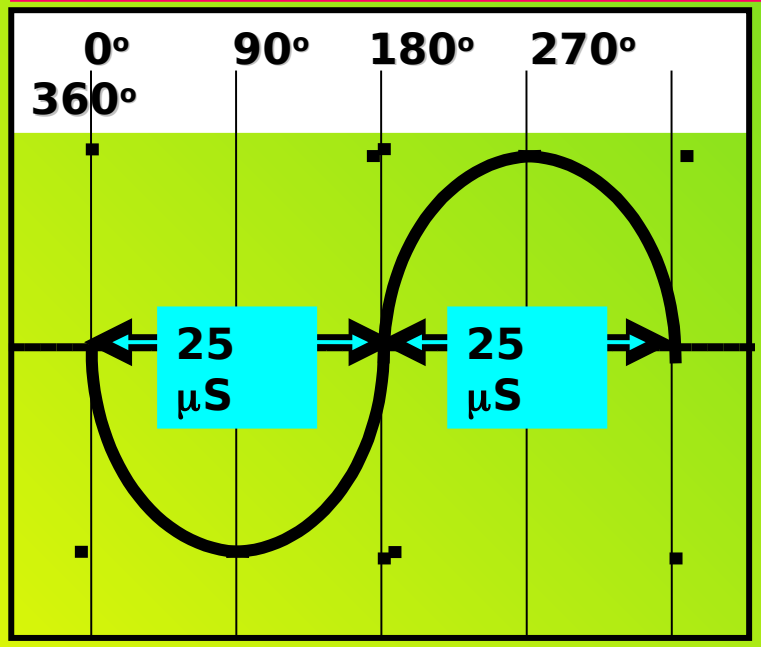




Frequency Calculations

AC: Intro To AC; Calculations

Calculate; Determine from the illustration the information given, then calculate the required unknowns.



PW = _____

Period = _____

Freq = _____

PW = 25 µS

Period = 2 X PW

Freq = P 1/X

Note:

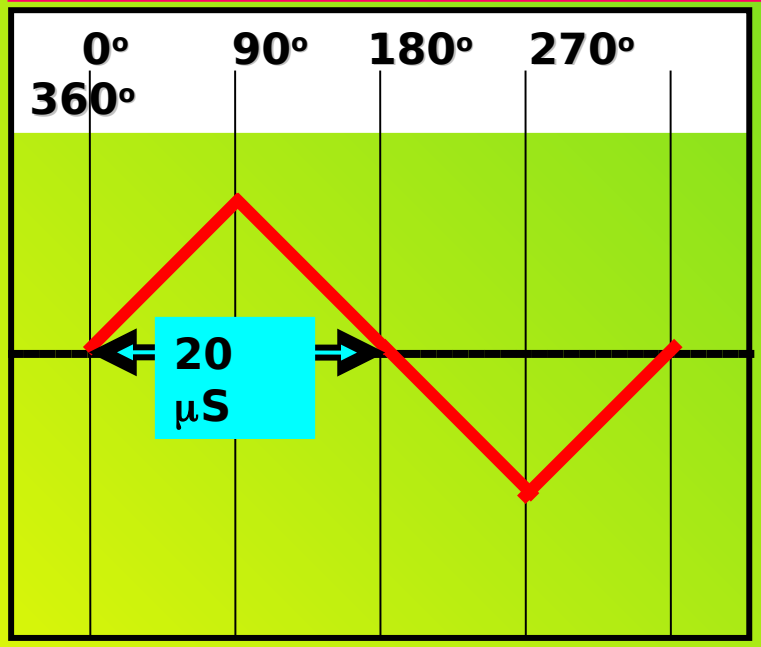
If there is µS in the Period, there will be KHz in the Frequency.

50 EE $^{-6}$ 1/X ⇒ 20000. = 20 KHz

Calculations Cont.

AC: Intro To AC; Calculations

Calculate; Determine from the illustration the information given, then calculate the required unknowns.



PW = _____

Period = _____

Freq = _____

PW = ½ P

Period = 2 X PW

Freq = P 1/X

Note:

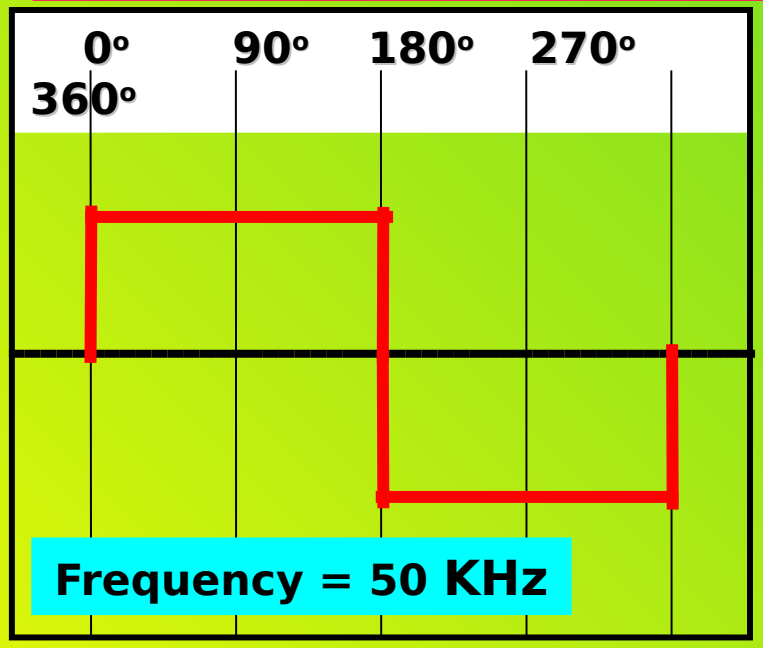
If there is µS in the Period, there will be KHz in the Frequency.

P EE -6 1/X ⇒ Freq in KHz

Calculations Cont.

AC: Intro To AC; Calculations

Calculate; Determine from the illustration the information given, then calculate the required unknowns.



Freq = _____

Period = _____

PW = _____

Freq = P 1/X

Period = Freq 1/X

PW = ½ P

Note:

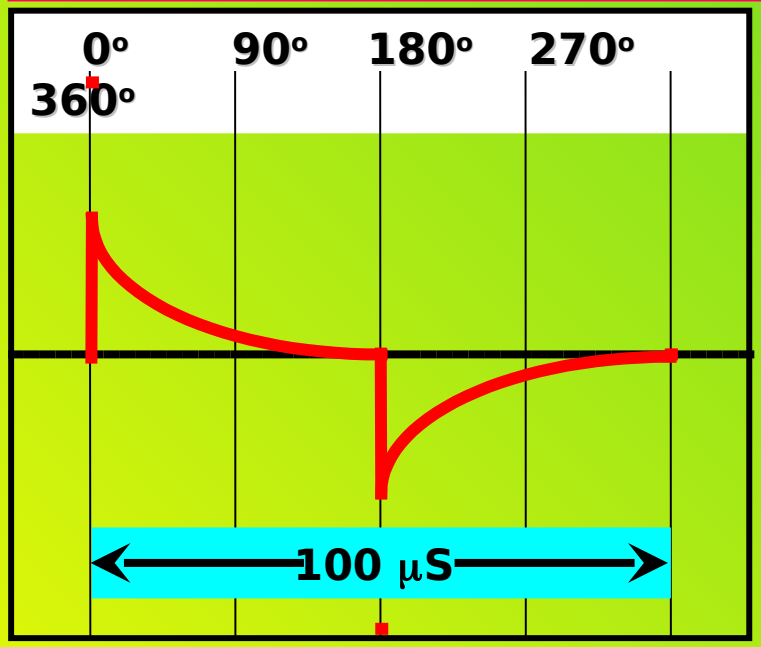
If there is KHz in the Frequency, there will be μS in the Period.

Freq EE 3 1/X ⇒ Period in μS

Calculations Cont.

AC: Intro To AC; Calculations

Calculate; Determine from the illustration the information given, then calculate the required unknowns.



Freq = _____

Period = _____

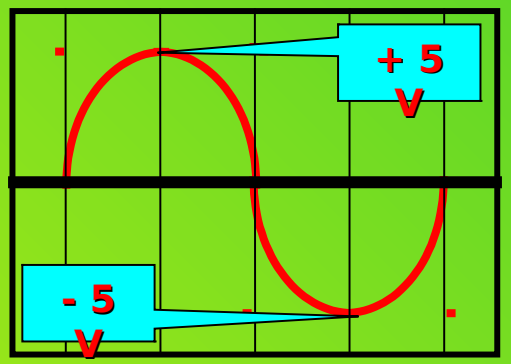
PW = _____

Problem Sheets

AC: Intro To AC ; Problem Sheets

Problem Sheets;

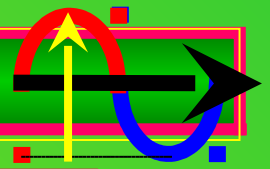
1. What is the magnetic lines of force called ? _____
2. What is the Law of Magnets ? _____
3. How many degrees are there in an AC Alternation ? _____
4. What is the peak Voltage of the waveform ? _____
5. What is the peak to peak Voltage of the waveform ? _____
6. How many alternations are there in a complete AC waveform ? ___



7. When using the Left Hand Rule, what property is represented by the thumb ? _____
8. Which of the three types of magnets will be magnetized during the time that Current is flowing through the conductor wrapped around a core ? _____

Answers 1-8.

AC: Intro To AC ; Problem Sheets



Problem Sheets;

9. The Effective Voltage is 20V. What is the Peak Voltage ?

   _____

10. The Peak Voltage is 50 V. What is its RMS Voltage ?

    _____

11. The Peak to Peak Voltage is 60V. What is its Effective voltage?

12. The RMS Voltage is 15 V. What is the Peak to Peak Voltage ? _____

13. The Alternation below the 0V reference line is called the _____ alternation.

14. The Peak Voltage of a waveform is 10 V. The Peak to Peak Voltage is

    _____

15. The RMS Voltage is 5 V, what is the Peak Voltage ?

16. The Peak Voltage is 20V, what is the RMS Voltage ? _____

17. The RMS is 7 V, what is the Peak to Peak ? _____

PP ÷ 2 = P

P X .707 = RMS or EFF

RMS X 1.414 = P

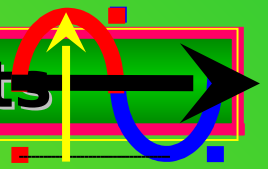
PP ÷ 2.828 = RMS

RMS X 2.828 = PP

P X 2 = PP

Answers 9-17.

AC: Intro To AC ; Problem Sheets



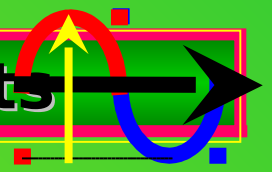
Problem Sheets; Frequency Calculations

1. Period = 5 m Sec	Frequency = _____
2. Period = _____	Frequency = 100 KHz
3. Period = 40 μ Sec	Frequency = _____
4. Period = _____	Frequency = 20 Hz
5. Period = 80 μ Sec	Frequency = _____
6. Period = _____	Frequency = 50 Hz
7. Period = 50 μ Sec	Frequency = _____
8. Period = _____	Frequency = 25 Hz

μSec	⇄	KHz
m Sec	▯	Hz

Answers 1-8.

AC: Intro To AC ; Problem Sheets



Problem Sheets; Frequency Calculations

9. Period = 100 m Sec Frequency = _____

10. Period = _____ Frequency = 4 KHz

11. Period = 15 μ Sec Frequency = _____

12. Period = _____ Frequency = 8 KHz

13. Period = 60 m Sec Frequency = _____

14. Period = _____ Frequency = 30 KHz

15. Period = 25 μ Sec Frequency = _____

μ Sec □ KHz

m Sec □ Hz

Answers 9-15.

AC: Introduction To Alternating Current

SUMMARY & QUESTIONS;

LESSON TEST;

Time; **20 Minutes.**

References; **Official OMEMS Training Aids.**

Standard; **7 of 10, minimum passing score.**